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SOLAR EUV FLUX-DATA ANALYSIS FOR EUVS EXPERIMENTS ON THE AE-SAT--ETC(U)

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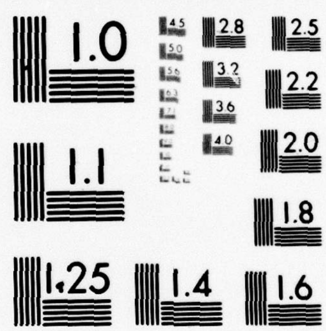


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# Solar EUV Flux-Data Analysis for EUVS Experiments on the AE-Satellites.

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FOR THE COMMANDER

John Howard

Chief Scientist

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>One of two tasks that the Extreme Ultraviolet Spectrometers (EUVS) on-board the Atmosphere Explorer Satellites perform is flux analysis of the solar spectrum. This analysis deals with two types of data: "fixed wavelength flux data" and "flux scan data." Both types are created by programs accessing the basic daily EUVS data (one file per vehicle per day). Information on time variation in solar flux for longer periods is provided in two forms, one giving wavelength flux data and the other flux scan data. The latter covers the entire solar spectrum in the range 140 to 1850 Å. | | |

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# Solar EUV Flux - Data Analysis for EUVS Experiments on the AE - Satellites

## 1. INTRODUCTION

The Extreme Ultraviolet Spectrometer (EUVS) instruments on the Atmosphere Explorer (AE) satellites were designed to measure the spectrum of the sun at wavelengths from 140 to 1850 Å (14 to 185 nm). Two major types of analyses performed are: (1) Flux analysis, which seeks to determine the actual solar radiation spectrum in this region; and (2) absorption analysis, which evaluates the structure of the thermosphere using measurements of the atmospheric absorption at various fixed wavelengths of solar EUV emissions. This report is limited to the former; for a description of the latter, reference is made to a report by Chaikin and Fukui.[1]

### 1.1 Instrumental Overview

The design of the EUVS instrument has been treated in detail by Hinteregger et al,[2] it will not be covered here, except to the extent necessary for clarification of the terminology. The instrument consists of an assembly of 24 grating spectrophotometers that share some components and are therefore not independently

(Received for publication 22 February 1979)

1. Chaikin, L. M., and Fukui, K. EUV-Absorption Data Analysis for EUVS Experiments on the AE-Satellites (to be published).
2. Hinteregger, H. E., Bedo, D. E., and Manson, J. E. (1973) The EUV spectrophotometer on Atmosphere Explorer, Radio Science, 8(No. 4):349-359.

operable. Twelve of these spectrophotometers are capable of scanning a range of wavelengths. Each of these "scan monochromators" has 128 wavelength positions (or steps). The actual center wavelengths at all of the steps of each monochromator are, fortunately, reproducible, owing to the design of the instrument. The twelve nonscan monochromators respond to fixed wavelengths selected for atmospheric absorption analysis.[1, 2]

### 1.2 Categories of Flux Data Analysis

Flux analysis of EUVS data is basically concerned with two types of study. In the first, a limited number of fixed wavelengths are considered, and the variations of solar flux at these wavelengths studied over various time spans (see Table 1). A data base of results on fluxes at these wavelengths has been created for all times of favorable observing conditions. This data base will be called "fixed wavelength flux data." The second type of study treats the entire range of wavelengths of incident solar EUV radiation. Obviously, the latter requires a data base of entirely different structure. It will be called "flux scan data." The analysis of each type of data will be described separately since there is little in common between the two phases of analysis.

Table 1. Standard Wavelengths Used for Fixed-Wavelength Data

| Number* | Wavelength (Å) | Monochromator | Step | Note |
|---|---|---|---|---|
| 1 | 175 (FeX) | 1 | 64 | ... |
| 2 | 1026 (H Ly-$\beta$) | 6 | 24 | Differs from No. 2 of absorption; available from AE-C only. |
| 3 | 584 (HeI) | 5 | 64 | ... |
| 5 | 855 | 10 | 64 | Available from AE-E only. |
| 6 | 1609 | 12 | 64 | Available from AE-E only. |
| 7 | 1457 | 12 | 24 | ... |
| 12 | 304 (HeII) | 15 | Nonscan | Restricted field of view. |
| 13 | 304 (HeII) | 16 | Nonscan | Available from AE-E only; nearly full disk. |
| 13 | 610 (MgX) | 16 | Nonscan | Available from AE-C only; restricted field of view. |
| 14 | 465 (NeVII) | 17 | Nonscan | Restricted field of view. |
| 15 | 584 (HeI) | 18 | Nonscan | Restricted field of view. |

*Missing numbers are accounted for by wavelengths used exclusively for absorption analysis.

### 1.3 Data Base of GU Files

#### 1.3.1 GU FILES OF ALL EUVS DATA PER DAY ("GU1"-files)

The primary data base of all geophysical observations made by the EUVS experiments on the satellites AE-C, D, and E consist of files designated as "GU1" files. The names of these GU1 files in the EUVS account of the AE-dedicated Xerox Sigma-9 computer data management facility (DMF) reflect the vehicle identification and date. Creation of these "day files" for each vehicle as well as updating or read-access can be accomplished only via the aforementioned DMF on the Sigma 9. These GU1 files of EUVS data belong to the variety of so-called "GU FILES" within the AE DMF, where the so-called "GU-FILENAME" has the form of ACCT. FILENAM[1] where ACCT is the account name of an authorized investigator (for example, ACCT=EUVS in our case) and FILENAM is the filename within that investigator's account (for example, FILENAM=GSYYDDD with S = U, D, or E GU1-data for day DDD of year 19YY for the satellite AE-C, D, or E, respectively). All GU files are written as binary files with date-time keyed records of a maximum length of 1000 words. In our case of GU1 files of EUVS data, each record contains data of one 8-sec time interval corresponding to one so-called major frame of telemetry data (TM data base also handled by DMF). To save file space, the GU1-file records include many 32-bit words of data on more than one instrumental/observational quantity.

This means that the access of these GU1 data for further processing by either flux- or absorption-analysis programs not only requires operation through the DMF but also involves an appropriate "unpacking routine." Therefore the utility of GU1 files, or of any AE GU files for that matter, is envisioned to remain viable only as long as the AE-dedicated Sigma-9 and associated DMF are indeed available. This restriction is, of course, regrettable for any plans of continuing scientific evaluation of AE observations beyond the eventual cutoff date of the actual availability of this whole AE-dedicated computer system. To mitigate the projected impact of this restriction on planned follow-on analyses, various programs have been developed recently, allowing the creation of DMF-independent EUVS data files to be placed on magnetic tapes for this projected future use. Some of these programs in the area of flux data are covered in the present report; others are still under development and will be covered in a future report.

The 21 quantities of EUVS data produced from each major frame (8 sec) of TM are listed in the first part of Table 2 (Unpacked Data). To reduce storage space requirements, these 21 quantities are "packed" before the actual GU1-file records are written. The packing is shown in the second part of Table 2.

### 1.3.2 AE-E EUVS SCAN DATA BASE ("SE"-files)

Data management facility-controlled GU files of EUVS data exist not only in the form of the aforementioned general GU1 files of EUVS data but also in the form of GU files of results of absorption observations,[1] and of EUVS-scan data results. Full-scan data including all of the 128 wavelength steps of each of the scan-capable monochromators, MN#1 through #12, have been produced for observations from the AE-E satellite only. There are two reasons for this restriction: the instrumental imperfection of the AE-C instrument described in publications by Hinteregger[3] and Hinteregger et al;[4] and the short life of the AE-D satellite for which only six weeks of EUVS observations exist. For the latter, only diagnostic evaluations have been performed, since the total lifetime was deemed insufficient to reach photometric stability to the extent required for a systematic scientific data production. The GU files of AE-E flux-scan data are discussed in Section 3 of the present report.

## 2. FIXED-WAVELENGTH FLUX DATA

Fixed-wavelength data, obtained from both AE-C and AE-E, are first processed into fixed-wavelength files (FWF) which are then accessed by a number of fixed-wavelength flux-analysis programs. Each FWF (binary file) contains data for a single satellite and wavelength, with records covering time spans which at the outset are arbitrarily chosen. The detailed structure is described in Table 3. The creation of FWF data is accomplished by one of three programs. One program (BRG022) directly accesses the basic daily EUVS data files (GU1 files; see Section 1.3.1); a second program (BRG023) accesses GU files of EUVS absorption data (see companion report[1]); the third (BRG020) can be employed to process manually-entered data. However, the primary usage is not manual data entry but further processing of FWF files created originally for the most part by BRG023, including various corrections as described below. Most of the presently existing FWF data records were created in their initial form by running Program BRG023 accessing the existing large GU-data base of absorption results. Since that data base had already been reduced substantially by the absorption analysis program (LMC80 described in companion report,[1]) the equivalent creation of initial FWF records by BRG022 accessing GU1 files would have been much less economical. The records

3. Hinteregger, H.E. (1976) EUV fluxes in the solar spectrum below 2000 Å, J. Atmos. Terr. Phys. 38:791-806.
4. Hinteregger, H.E., Bedo, D.E., Manson, J.E., and Skillman, D.R. (1977) EUV flux variations with solar rotation observed during 1974 from AE-C satellite, Space Research XVIII, pp. 533-544.

of FWF's created by the programs BRG022 and BRG023 are still essentially raw signal data, containing dummy words to be subsequently replaced by data corrected for instrumental effects and for atmospheric absorption. This is accomplished by the program BRG020 used in its main mode—updating files created by BRG023.

Table 3. Structure of Fixed-Wavelength File Records*

| Word Number | Contents in Even-numbered Records (10 words) | Contents in Odd-numbered Records (11 words) |
|---|---|---|
| 1 | Date (integer of form yyddd) | Orbit number (as real number) |
| 2 | Time (UT, seconds, as integer) | Latitude (degrees, real number) |
| 3 | Raw signal (counts, as real) | Longitude east from Greenwich (degrees) |
| 4 | Instrumentally-corrected signal (counts, as real) | Altitude (kilometers, real number) |
| 5 | Signal corrected by "default model" (counts, as real) | Local time (hours, real number) |
| 6 | Signal corrected by Jacchia 1971 model (counts, as real) | Invariant latitude (degrees, as real) |
| 7 | Signal corrected by MSIS model (counts, as real) | Solar zenith angle (degrees, as real) |
| 8 | (Reserved) | Height of probing point (kilometers) |
| 9 | (Reserved) | Latitude of probing point (degrees) |
| 10 | (Reserved) | Longitude of probing point (degrees) |
| 11 | ... | Local time at probing point (hours) |

*Each file contains a header record of two words. Word No. 1 contains a satellite identification (character "C" for AE-C data, "E" for AE-E data). Word No. 2 contains, as a binary integer, the standard wavelength number (column 1, Table 1) represented by the file. Subsequent records are in even-odd pairs; two records per observation.

The first updating correction performed by Program BRG020 is the subtraction of backgrounds. This is done by computing the background content (B) of the raw signal (R) using the relation

$$B = B_{ref} \frac{R}{S_{ref} + B_{ref}} \tag{1}$$

where $B_{ref}$ and $S_{ref}$ are the reference values of background and corrected signal, respectively, which are different for each observed wavelength. This formula expresses the assumption that the background is simply proportional to the

unattenuated raw signal. The values $B_{ref}$ and $S_{ref}$ as shown in the files $AREF:C (for the AE-C satellite) and $AREF:E (for the AE-E satellite) are displayed in Table 4. The second instrumental type of correction concerns departures from true "plateau" counting by the channel electron multiplier (CEM) detectors,* involving the multiplication of the raw signal by an appropriate factor (f) in order to correct the signal to a level equivalent to that which would have been observed by counting in the "plateau." For most of the detectors, the ideal plateau operation has been approached by operation of the CEM's at the highest available high voltage, designated as level 4. In most cases analyzed so far, it has been sufficient to express these correction factors as linear functions of time (orbit number) for certain sequences of time of operation at a given HV level,

$$f = a_{s\ell} + b_{s\ell} (n - c_{s\ell}) , \tag{2}$$

where n is the orbit number, s the satellite designator [either C (s=3) or E (s=5) and $\ell$ is the high-voltage level (1, 2, or 3)]. The values of $a_{s\ell}$, $b_{s\ell}$, and $c_{s\ell}$ are tabulated in Table 5. For $n > 7332$ (for AE-C) or $n > 5284$ (for AE-E), the high-voltage level has been at its maximum (level 4) and no correction deemed necessary so far in general; that is, $f = 1$, except for MN#3 and MN#4. It should be noted that for AE-C, only data from at least high-voltage level 3 are used, and that certain monochromators are not considered, because their wavelength ranges do not include any of the wavelengths employed for the flux data analysis of AE-C data. The signal as corrected for background and high-voltage level, called "instrumentally-corrected" signal, is inserted into the FWF's by the updating use of program BRG020.

A third type of correction—the correction for residual atmospheric absorption—is also necessary. Since this correction is dependent upon atmospheric model assumptions and a set of absorption cross sections (see Table 6), instrumentally-corrected values are retained alongside the absorption-corrected signals in the FWF records, as it is advisable to preserve data that are independent of these assumptions in order to allow for possible future use of different atmospheric models. Three models of atmospheric structure are used and separate corrected columns of results maintained for each; however, the structure of the file provides for three more, should they be adopted in the future (see Table 3). These three presently installed models are a simplified "default model," the MSIS model of Hedin et al[5,6]

*"C"-type, made by Bendix.

5. Hedin, A.E., Salah, J.E., Evans, J.V., Reber, C.A., Newton, C.P., Spencer, N.W., Kayser, D.C., Alasyde, C., Bauer, P., Cogger, L., and McClure, J.P. (1977) A global thermospheric model based on mass spectrometer and incoherent scatter data: MSIS Part 1 - $N_2$ density and temperature, J. Geophys. Res. 82:2139.

6. Hedin, A.E., Reber, C.A., Newton, C.P., Spencer, N.W., Brinton, H.C., Mayr, H.G., and Potter, W.E. (1977) A global thermospheric model based on mass spectrometer and incoherent scatter data: MSIS Part 2 - composition, J. Geophys. Res. 82:2148.

and the so-called Jacchia 1971 model adopted for COSPAR International Reference Atmosphere 1972.[7] The "default model" uses particle number densities taken from the Jacchia 1971 model listed for exospheric temperature of 800°K at the height of 250 km; its use is intended only for altitudes reasonably close to that height, since this default model simply scales densities by an exponential factor for the difference in altitude from 250 km. Values of the residual optical depth are calculated with each of these three models by a method described in detail in the companion report.[1]

Table 4. Listing of Background Reference Files $AREF:C and $AREF:E (The following listing shows the values of $S_{ref}$ and $B_{ref}$ [as used in Eq. (1)] for all fixed wavelengths. The tabulated values are for 20 fixed wavelengths, of which only the 10 defined in Table 1 are actually in use for flux analysis.)

File $AREF:C

| | |
|---|---|
| 1.000 | 'C' (DO NOT CHANGE C BELOW) REFERENCE FILE, NEW FOR L = 2 |
| 2.000 | C |
| 3.000 | BREF(L), L=1, 10/L=11, 20 (XXX.X,) |
| 4.000 | 1.5, 2.7, .5, 80., 50., 125., 110., 120., 110., 8., |
| 5.000 | 2., 2.5, 2.8, 26., 37., 25., 25., 0., 85., 80., |
| 6.000 | SOREF(L), L=1, 5/L=6, 10/L=11, 15/L=16, 20 (XXXXX.X,) |
| 7.000 | 460., 2700., 2100., 1000., 400., |
| 8.000 | 3800., 950., 6600., 9200., 10100., |
| 9.000 | 80., 75., 81., 450., 210., |
| 10.000 | 700., 600., 100., 3320., 2330., |
| 11.000 | |

File $AREF:E

| | |
|---|---|
| 1.000 | 'E' (DO NOT CHANGE E BELOW) REFERENCE FILE, NEW FOR L = 2 |
| 2.000 | E |
| 3.000 | BREF(L), L=1, 10/L=11, 20 (XXX.X,) |
| 4.000 | .6, 1.2, .2, .9, 2., 22.5, 25.7, 22.8, 22.9, 1.6, |
| 5.000 | 1., .4, .4, 1.2, .1, 2., 1.6, .2, 12.4, .8, |
| 6.000 | SOREF(L), L=1, 5/L=6, 10/L=11, 15/L=16, 20 (XXXXX.X,) |
| 7.000 | 861., 1200., 4005., 1516., 1710., |
| 8.000 | 701., 220., 550., 1840., 1648., |
| 9.000 | 317., 690., 14188., 259., 623., |
| 10.000 | 924., 1081., 15.5, 355., 2127., |
| 11.000 | |

7. Jacchia, L.G. (1972) Atmospheric models in the region from 110 to 2000 km, in COSPAR International Reference Atmosphere 1972, Akademie-Verlag Berlin, pp. 227-338.

Table 5. Instrumental Correction Factors for High-Voltage Level

| Monochromator Number | $a_{33}$ | $b_{33}$ | $c_{33}$ | $a_{51}$ | $b_{51}$ | $c_{51}$ | $a_{52}$ | $b_{52}$ | $c_{52}$ | $a_{53}$ | $b_{53}$ | $c_{53}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0 | 4732 | 1.01 | 0.00019 | 395 | 1.015 | 0.0000332 | 864 | 1.015 | 0 | 2088 |
| 2 | 1.00 | 0 | 4732 | 1.01 | 0.00019 | 395 | 1.015 | 0.0000332 | 864 | 1.015 | 0 | 2088 |
| 3 | ...* | ... | ... | 1.03 | 0.00285 | 395 | 1.13 | 0.00275 | 864 | 1.037 | 0.00049 | 2088 |
| 4 | ... | ... | ... | 1.03 | 0.00285 | 395 | 1.13 | 0.00275 | 864 | 1.037 | 0.00049 | 2088 |
| 5 | 1.00 | 0.0000268 | 4732 | 1.01 | 0.00182 | 395 | 1.23 | 0.0000327 | 864 | 1.08 | -0.00001 | 2088 |
| 6 | 1.00 | 0.0000268 | 4732 | 1.01 | 0.00182 | 395 | 1.23 | 0.0000327 | 864 | 1.08 | -0.00001 | 2088 |
| 7 | ... | ... | ... | 1.01 | 0.00057 | 395 | 1.18 | 0 | 864 | 1.08 | -0.000022 | 2088 |
| 8 | ... | ... | ... | 1.01 | 0.00057 | 395 | 1.18 | 0 | 864 | 1.08 | -0.000022 | 2088 |
| 9 | ... | ... | ... | 1.01 | 0.0006 | 395 | 1.12 | 0.000016 | 864 | 1.05 | 0 | 2088 |
| 10 | ... | ... | ... | 1.01 | 0.0006 | 395 | 1.12 | 0.000016 | 864 | 1.05 | 0 | 2088 |
| 11 | 1.00 | 0 | 4732 | 1.00 | 0 | 395 | 1.00 | 0 | 864 | 1.00 | 0 | 2088 |
| 12 | 1.00 | 0 | 4732 | 1.00 | 0 | 395 | 1.00 | 0 | 864 | 1.00 | 0 | 2088 |
| 13 | 1.00 | 0.00001 | 4732 | 1.01 | 0.0004 | 395 | 1.09 | 0 | 864 | 1.05 | 0 | 2088 |
| 14 | 1.00 | 0.00001 | 4732 | 1.01 | 0.0004 | 395 | 1.09 | 0 | 864 | 1.05 | 0 | 2088 |
| 15 | 1.00 | 0.0000038 | 4732 | 1.2 | 0.00113 | 395 | 1.12 | 0.00128 | 864 | 1.05 | 0 | 2088 |
| 16 | 1.00 | 0.0000038 | 4732 | 1.2 | 0.00113 | 395 | 1.12 | 0.00128 | 864 | 1.05 | 0 | 2088 |
| 17 | 1.00 | 0.000058 | 4732 | 1.15 | 0.00156 | 395 | 1.25 | 0.00276 | 864 | 1.13 | 0.000266 | 2088 |
| 18 | 1.00 | 0.000058 | 4732 | 1.15 | 0.00156 | 395 | 1.25 | 0.00276 | 864 | 1.13 | 0.000266 | 2088 |
| 19 | ... | ... | ... | 1.02 | 0.000106 | 395 | 1.12 | 0.00038 | 864 | 1.06 | 0 | 2088 |
| 20 | ... | ... | ... | 1.02 | 0.000106 | 395 | 1.12 | 0.00038 | 864 | 1.06 | 0 | 2088 |
| 21 | ... | ... | ... | 1.00 | 0 | 395 | 1.11 | 0.0000278 | 864 | 1.04 | 0 | 2088 |
| 22 | ... | ... | ... | 1.00 | 0 | 395 | 1.11 | 0.0000278 | 864 | 1.04 | 0 | 2088 |
| 23 | ... | ... | ... | 1.00 | 0 | 395 | 1.00 | 0 | 864 | 1.00 | 0 | 2088 |
| 24 | ... | ... | ... | 1.00 | 0 | 395 | 1.00 | 0 | 864 | 1.00 | 0 | 2088 |

*Shown here and elsewhere for monochromators on AE-C for which no absolute flux values are available.

Table 6. *Listing of the Model Reference File* $MODREF*

| | |
|---|---|
| .100 | MODKEY = DATE OF LAST REVISION YYDDMM |
| .200 | 770724 |
| 1.000 | MODEL REFERENCE HEIGHT IN KM |
| 2.000 | 250.0 |
| 3.000 | MODEL KINETIC GAS TEMPERATURE IN DEGREES KELVIN |
| 4.000 | 764.0 |
| 5.000 | MODEL PARTICLE NUMBER DENSITY OF O1 (#/CU METER) |
| 6.000 | 1.318257E+15 |
| 7.000 | MODEL PARTICLE NUMBER DENSITY OF N2 (#/CU METER) |
| 8.000 | 1.940886E+14 |
| 9.000 | MODEL PARTICLE NUMBER DENSITY OF O2 (#/CU METER) |
| 10.000 | 1.061696E+13 |
| 11.000 | MODEL PARTICLE NUMBER DENSITY OF HE (#/CU METER) |
| 12.000 | 7.886801E+12 |
| 13.000 | SIGMA(O1), SIGMA(N2), SIGMA(O2), IN MEGABARNS |
| 14.000 | 3.5, 5.1, 0.0, 0.0 |
| 15.000 | 10.2, 21.8, 0.0, 0.0 |
| 16.000 | 13.0, 23.0, 0.0, 200. |
| 17.000 | 9.3, 80.0, 22.7, 0.0 |
| 18.000 | 7.2, 36.0, 13.4, 0.0 |
| 19.000 | 0.0, 0.0, 4.7, 0.0 |
| 20.000 | 0.0, 0.0, 14.0, 0.0 |
| 21.000 | 0.0, 0.0, 0.9, 0.0 |
| 22.000 | 0.0, 0.0, 0.4, 0.0 |
| 23.000 | 0.0, 0.0, 0.01, 0.0 |
| 24.000 | 7.1, 9.6, 0.0, 0.0 |
| 25.000 | 9.0, 11.6, 0.0, 0.0 |
| 26.000 | 13.1, 23.1, 0.0, 0.0 |
| 27.000 | 10.2, 21.8, 0.0, 0.0 |
| 28.000 | 13.0, 23.0, 0.0, 200. |
| 29.000 | 0.0, 0.0, 1.5, 0.0 |
| 30.000 | 0.0, 0.7, 4.0, 0.0 |
| 31.000 | 0.0, 0.0, .01, 0.0 |
| 32.000 | 0.0, 0.0, 5.7, 0.0 |
| 33.000 | 0.0, 0.0, 0.03, 0.0 |

*This listing shows the values of reference temperature and altitude used in the default model for absorption correction of fixed wavelength files, the assumed particle number densities for the default model, and the absorption capture cross sections used for all three models. It should be noted that the cross sections for wavelength 2 in this file are not used; they refer to the wavelength designated as number 2 in absorption analysis, and flux software automatically uses the line appropriate to wavelength 16 (the same 1026 Å H Lyman-$\beta$ line as flux wavelength 2) when appropriate.

To correct for absorption, two cases must be differentiated, as indicated in Figures 1 and 2. If the solar zenith angle ($\chi$ in Figure 1) is less than 90°, the satellite is itself at the bottom of the column of atmosphere through which the radiation passes. Thus the absorption is dependent primarily on the actual satellite altitude. For solar zenith angles greater than 90° (Figure 2) the radiation passes

through a portion of the atmosphere that is indeed lower than the satellite and consequently denser. As a result, most of the absorption occurs, not at the satellite, but at a "remote-proving point" Q defined as the point of minimum ray height of the line of sight from the satellite toward the sun. The height of that probing point $h_Q$ is then in fact more important for the absorption than is the actual satellite height $h_s$. Based on the values of the solar zenith angle and, as appropriate, either $h_Q$ or $h_s$, the model values of residual optical depth, $\tau(S_o)$ are determined and the resulting values of the absorption-corrected unattenuated signal, $S_{corr}$, are obtained as

$$S_{corr} = S_{ic}\, e^{\tau}, \tag{3}$$

where $S_{ic}$ is the instrumentally-corrected signal.

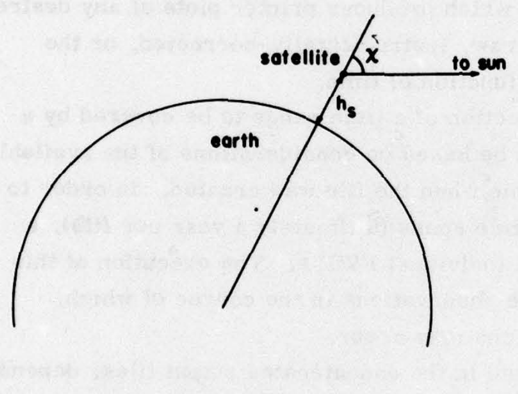



Figure 1. Quantities Used in Absorption Correction for Solar Zenith Angle < 90°

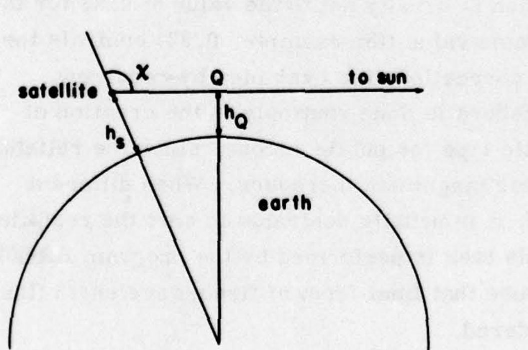



Figure 2. Quantities Used in Absorption Correction for Solar Zenith Angle > 90°

Fixed wavelength files created by Programs BRG020, BRG022, and BRG023 contain the orbit parameters (Table 3) used in the calculations of absorption corrections, and they are thus accessible to investigators wishing to employ other models of the atmosphere without requiring availability of the AE DMF and associated orbit-attitude data base.

A table containing any desired subset of the data in the FWF's can be produced by the use of a display program (BRG021). Although these displays can include any requested subset of the data, the standard procedure is to create tabular files containing a set of fifteen quantities for all times included within a file: the date and time, the raw and instrumentally-corrected signals, the absorption-corrected signal values using the three cited models, and eight selected orbital parameters. Five of these eight (latitude, longitude, altitude, local time, and solar zenith angle) refer to the satellite position itself and three (latitude, altitude, and local time) refer to the remote probing point. The signal values can also be displayed in graphical form, using a display program (BRG029) which produces printer plots of any desired combination of the five signal quantities (raw, instrumentally-corrected, or the three absorption-corrected signals) as a function of time.

As mentioned earlier, the initial selection of a time range to be covered by a fixed wavelength file is arbitrary. It can be based on considerations of the available disk space and of available processing time when the file was created. In order to provide for continuous coverage of long time spans (ultimately a year per file), a program (BRG025) is used to concatenate individual FWF's. The execution of this program provides for elimination of those observations in the course of which, exceptionally large instrumental corrections may occur.

These occurrences are then eliminated in the concatenated output files, depending on an input parameter of BRG025 which is usually set to the value of 0.33 for the maximum allowed value of $\tau(S_o)$. The same value (for example, 0.33) controls the maximum allowed value of instrumental correction, for example, by requiring $S_{ic}/S_o \leq \exp(0.33)$. This filtering procedure is done routinely in the creation of concatenated data files placed on magnetic tape for public access, since the reliability of these corrections decreases as their magnitude increases. When different files are concatenated by this procedure, it is usually desirable to sort the resulting file records into chronological order; this task is performed by the program BRG026, executed routinely after BRG025, to ensure that final form of fixed-wavelength flux data files are always chronologically ordered.

Another class of fixed-wavelength flux data files is created to facilitate the study of long-term variations. These may be called "summary files," as they consist of condensed data from both satellites, AE-C and E, covering a whole year for appropriately selected sets of wavelengths. The structure of these summary files is detailed in Tables 7a and 7b. These files are created from the single-wavelength FWF's

by an abstracting program (BRG028). Their records contain only the corrected signals using the "preferred model," that is, the MSIS model, for the absorption correction. In the case of two or more observations taken in a single day, observations are averaged, and the number of such observations, together with a measure of scatter of the individual readings around that daily average, inserted as a "figure of merit" (see Table 7a). The summary files herein described can be used as input by two other study-utility programs which produce tabulated results of running, time-smoothed averages, either for signals at a selected wavelength as observed by a selected satellite (program BRG050) or ratios of any two such signals, selected as input to the comparison program BRG051. In addition, running averages of signals can be prepared directly from FWF's by still another study-utility program (BRG052); the last mentioned program is used for those combinations of satellite and wavelength which are not abstracted by program BRG028, and the resulting tables are identical to those produced by BRG050.

Table 7a. Structure of Fixed Wavelength Summary File Record (Each record consists of data for one combination of satellite and wavelength, in the fixed order shown in Table 7a.)

| Word Number | Quantity | Real or Integer |
|---|---|---|
| 1 | Average signals for day 1 (corrected counts) | R |
| 2 | Figure of merit* | I |
| 3-732 | Same for days 2-366 (words 731-732 are zero in nonleap years) | |

*Figure of merit is a coded integer of the form nnxxxiii, where nn is the number of entries averaged, xxx is the deviation between the highest signal of the day and the mean, expressed as a percentage of the mean, and iii is the deviation between the lowest signals of the day and the mean, expressed as a percentage of the mean.

Table 7b. Sequence of Records in Summary Files

| Record Number | Satellite | Wavelength Number (See Table 1) |
|---|---|---|
| 1 | AE-C | 1 |
| 2 | AE-C | 3 |
| 3 | AE-C | 12 |
| 4 | AE-C | 13 |
| 5 | AE-C | 14 |
| 6 | AE-C | 15 |
| 7 | AE-E | 1 |
| 8 | AE-E | 3 |
| 9 | AE-E | 5 |
| 10 | AE-E | 12 |
| 11 | AE-E | 13 |
| 12 | AE-E | 14 |
| 13 | AE-E | 15 |

## 3. FLUX SCAN DATA

Scanning data covering all wavelengths from 140 to 1850 Å are available only from AE-E. Due to the hardware malfunction, the instrument on AE-C is incapable of sampling all steps of all monochromators; in fact, only half of the monochromators can be used.[3,4] Certain aspects of this scan-data processing resemble certain processes of fixed-wavelength data analysis (see Section 2), but the most important aspects are quite different. Nevertheless, the general processing philosophy is the same. In particular, the various types of refinement are again executed in successive steps, that is, by different programs, with results of each step stored to guarantee "traceability" and to facilitate follow-on studies with perhaps slightly modified instructions selected for the analysis at some given step without requiring a complete repetition of all lower-level processing.

Initially, the sections of the GU1 files (see Section 1.3.1) for days containing flux-scan observations are processed by a program called 1FLUXDO which creates the basic raw scan data file (RSF). These files are updated by insertion of additional data, calculated by program 1SEMOD, which extracts associated geophysical conditions from the AE orbit-attitude data base (OA data handled by AE DMF) and calculates the average great-circle distance from the nominal center of the South-Atlantic Anomaly for each RSF record. The structure of these updated RSF records are described in Table 8 (words 1-868 are inserted by 1FLUXDO, the remaining

data by 1SEMOD). No corrections for instrumental or atmospheric effects are made in creating the RSF's. However, any grossly aberrant data are indeed filtered out by reference to a detailed table of minimum and maximum acceptable values of count samples for each step of each monochromator. The RSF's can be displayed by the program 1WAVES which gives count-sums and associated scan start and end times for specified wavelength ranges, and specified periods of time covering many individual RSF records; or, in more detail, the program 1SCANPAGE gives a total display of all information in any given individual RSF record. A graphical display of signal vs step on a given monochromator is also available, as provided by the program 1SCANPLOT.

Table 8. Structure of Raw Scan File Records (These files are in the form of "Geophysical Unit" files. All words are in integer form; count samples are packed two to a word for the scanning monochromators by multiplying the first by 10,000 and adding the second.)

| Word Number | Quantity |
|---|---|
| 1 | Date of start of scan (yyddd) |
| 2 | Time of start of scan (UT, millisec) |
| 3 | Date of end of scan (yyddd) |
| 4 | Time of end of scan (UT, msec) |
| 5-36 | (Reserved) |
| 37 | Count for monochromators 1 and 2, Step 1 |
| 38-164 | Count for monochromators 1-2, Steps 2-128 |
| 165-804 | Count for monochromators 3-12 |
| 805-816 | Count for nonscan monochromators (13-24) |
| 817-868 | Altitude of probing point at beginning and end of scan for each of 52 groups of wavelengths (packed) |
| 869-920 | Solar zenith angle (in tenths of degree) at beginning and end of scan for each of 52 groups of wavelengths |
| 921 | Altitude (km) at start of scan |
| 922 | Altitude (km) at end of scan |
| 923 | Average latitude (degrees) |
| 924 | Average longitude |
| 925 | Average invariant latitude |
| 926-927 | (Reserved) |
| 928 | Distance from South Atlantic Anomaly (deg) |
| 929 | Altitude of probing point at start of scan (km) |
| 930 | Altitude of probing point at end of scan (km) |
| 931 | Solar zenith angle at start of scan (tenths of deg) |
| 932 | Solar zenith angle at end of scan (tenths of deg) |
| 933-934 | (Reserved) |

The first step in the processing of the RSF's is creation of a set of corrected scan files (CSF's) with both instrumental and atmospheric effects included in the correction. The contents of these files are described in Table 9. The principal program (BRG040) for routine production of CSF's employs the MSIS model for absorption correction. A reference file required as input to these CSF-creating and accessing programs is reproduced in Table 10. This controlling input file includes three parts. The first part contains the threshold for absorption correction, a version number (to distinguish different versions of the file), the default model reference altitude, exosphere temperature, and particle-number densities. The second part is a table of altitudes of acceptable thresholds for distances from the South-Atlantic Anomaly (SAA) for a set of different altitudes. For each observation, the satellite altitude is matched against the listed altitudes in the table; for the first tabulated height value which is exceeded by the satellite altitude, if the SAA distance is less than the corresponding threshold, the observation is rejected, since the expected contamination of the observed count samples by charged particles is indeed not conducive to any reliable type of "correction." The third portion of the reference file contains definitions of eighty standard wavelength groups (WLG's) and parameters associated with each. The absorption cross section for use in the absorption correction is assumed not to vary within each of the WLG's. In other words, values of the residual optical depth, $\tau(S_o)$, are calculated only for the 80 WLG's, rather than for 1536 individual wavelengths (128 steps on each of the 12 monochromators). The procedure for background correction has been somewhat altered from that used in the operation of the FWF's described in Section 2. In a preliminary, now obsolete version of BRG040, reference values of backgrounds for each of the 80 WLG's (marked by daggers in Table 10) were used. However, subsequent experience gained with further processing including various stages of removing signal contributions due to higher orders of diffraction of shorter wavelengths, $\lambda_N = \lambda_1/N$ (N = order of diffraction; $\lambda_1$ = nominal wavelength appearing in first order) convinced the experimenter that the removal of "ordinary" background (that is, not that due to overlapping higher orders) should be deferred to the processing stage dealing with these higher-order backgrounds. Since this stage lies beyond that of the BRG040-peculiar level (for example, usually requiring already accomplished evaluation of quite a few BRG040-created CSF records), and since these higher-order backgrounds represent the dominant parts of the total backgrounds for many WLG's, the final version of BRG040 now does not apply any simplistic background correction. Where the latter is desired, a corresponding display can be created by the utility program BRG041BK, without altering the CSF data base. The two corrections, that is, for instrumental effects and atmospheric absorption described for FWF's are thus the only ones performed by BRG040. This is done for each of the 1536 wavelengths up to 25 observations averaged in each CSF output. This averaging is done

in a weighted calculation, in which each observation is assigned a weight, w, depending on the magnitude of the absorption correction:

$$w = 1 - \tau \, . \tag{4}$$

This is done in order to place greater emphasis on the resultant average in less-attenuated readings, due to some uncertainty in the absorption corrections.

From the CSF's, tabular data can be produced by any of several utility programs: A direct tabulation of the signal at each step of any or all monochromators is obtainable from Program BRG041; the ratio between signals in two different CSF's representing different solar conditions can be similarly tabulated by using program BRG041R.

Some of the flux scan data are illustrated in the diagrams of Appendices A, B, and C.

The figures of Appendix A show the uncorrected average counts per step for the range of 140 to 1850 Å from a single SE-file record which stems from observations of one flux-scan turnon of typically 5 to 10 minutes.

The data given in Appendices B and C, on the other hand, show corrected averages for a relatively large number of SE file records, for example, 24 different turnons in the case of the July 1976 data (Appendix B). The creation of these results is accomplished by the program BRG040 which includes a preliminary correction for scattered light backgrounds and a correction for residual atmospheric absorption.

A linear ordinate scale was used only for the plots of Appendix A. A logarithmic scale was used in the plots of Appendices B and C, since the latter data are characterized by a much better statistical significance of the signal averages in those regions of the spectrum where the instrumental response is relatively weak. The corresponding improvement in these weak-signal regions would have been lost, due to averaging, if the illustrations of Appendices B and C had also used a linear ordinate scale.

**Table 9. Structure of Corrected Scan File Records (Files consist of two classes of record: header records, containing specific data describing the run; and signal records, containing actual averaged signal and quality indications.)**

**Part 1: Header Record Structure (64-word record)**

| Word Number | Quantity | Real or Integer |
|---|---|---|
| 1 | Date #1 (yyddd) | I |
| 2 | Time #1 (UT, seconds) | I |
| 3-50 | (As for 1-2 for observations 2-25) | |
| 51 | Actual number of observations | I |
| 52 | Minimum $F_{10.7}$ value | R |
| 53 | Average $F_{10.7}$ value | R |
| 54 | Maximum $F_{10.7}$ value | R |
| 55 | Minimum Ap value | R |
| 56 | Average Ap value | R |
| 57 | Maximum Ap value | R |
| 58 | Minimum distance from South Atlantic Anomaly (SAA) (deg) | R |
| 59 | Maximum distance from SAA (deg) | R |
| 60 | Minimum satellite altitude (km) | R |
| 61 | Maximum satellite altitude (km) | R |
| 62 | Number of following records | I |
| 63 | Version code for parameters | I |
| 64 | Program Code (40 or 43) | I |

**Part 2: Signal Record Structure (513-word record) (Number of records is indicated by word 62 of header; one record for each monochromator surveyed.)**

| Word Number | Quantity | Real or Integer |
|---|---|---|
| 1 | Monochromator Number | I |
| 2 | Average corrected signal (counts) (Step 1) | R |
| 3 | Number of scans contributing to average (Step 1) | I |
| 4 | Standard deviation of count sample in average (Step 1) | R |
| 5 | Average optical depth corrected for in average (Step 1) | R |
| 6-512 | (Same as 2-5, for Steps 2-128) | |

Table 10. Listing of the Reference File BRG040F:3 Used in Scanning Data Analysis

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | .330 | .330 | 780119 | 250.0 | 764.0 | 1.318E 15 | 1.941E 14 | 1.062E 13 | 7.890E 12 | |
| 2.000 | 8 | 80 | | | | | | | | |
| 3.000 | 350. | 0. | | | | | | | | |
| 4.000 | 400. | 10. | | | | | | | | |
| 5.000 | 450. | 15. | | | | | | | | |
| 6.000 | 500. | 20. | | | | | | | | |
| 7.000 | 550. | 30. | | | | | | | | |
| 8.000 | 600. | 40. | | | | | | | | |
| 9.000 | 700. | 60. | | | | | | | | |
| 10.000 | 1600. | 70. | | | | | | | | |
| 11.000 | 1 | 1 | 1 | 45 | -200. | 4.899 | 3.801 | 9.395 | 0.000 | 0.0 |
| 12.000 | 2 | 1 | 46 | 69 | -600. | 5.591 | 4.854 | 6.612 | 0.000 | 0.0 |
| 13.000 | 3 | 1 | 69 | 94 | -600. | 6.023 | 5.494 | 7.392 | 0.000 | 0.0 |
| 14.000 | 4 | 1 | 95 | 110 | -600. | 6.405 | 6.002 | 8.007 | 0.000 | 0.0 |
| 15.000 | 5 | 1 | 111 | 128 | -500. | 6.741 | 6.610 | 8.633 | 0.000 | 0.0 |
| 16.000 | 6 | 2 | 1 | 20 | -200. | 7.161 | 7.392 | 9.541 | 0.000 | 0.0 |
| 17.000 | 7 | 2 | 21 | 72 | -200. | 8.034 | 9.006 | 11.682 | 0.000 | 0.0 |
| 18.000 | 8 | 2 | 73 | 104 | -200. | 9.028 | 10.309 | 14.179 | 0.000 | 0.0 |
| 19.000 | 9 | 2 | 105 | 128 | -200. | 9.491 | 11.101 | 15.440 | 0.000 | 0.0 |
| 20.000 | 10 | 3 | 1 | 28 | -200. | 9.983 | 14.055 | 17.109 | 0.000 | 0.0 |
| 21.000 | 11 | 3 | 29 | 78 | -400. | 10.554 | 16.791 | 17.943 | 0.000 | 0.0 |
| 22.000 | 12 | 3 | 79 | 128 | -200. | 6.413 | 6.033 | 8.030 | 0.000 | 0.0 |
| 23.000 | 13 | 4 | 1 | 13 | -300. | 6.785 | 6.696 | 8.728 | 0.000 | 0.0 |
| 24.000 | 14 | 4 | 14 | 40 | -300. | 11.386 | 21.510 | 19.528 | 0.000 | 0.0 |
| 25.000 | 15 | 4 | 41 | 61 | -300. | 7.516 | 8.070 | 10.321 | 0.000 | 0.0 |
| 26.000 | 16 | 4 | 62 | 68 | -400. | 11.222 | 21.830 | 20.403 | 0.000 | 0.0 |
| 27.000 | 17 | 4 | 69 | 95 | -300. | 8.061 | 9.098 | 11.702 | 0.000 | 0.0 |
| 28.000 | 18 | 4 | 96 | 100 | -300. | 11.772 | 21.958 | 22.016 | 0.000 | 0.0 |
| 29.000 | 19 | 4 | 101 | 128 | -400. | 8.469 | 9.685 | 12.871 | 0.000 | 0.0 |
| 30.000 | 20 | 5 | 1 | 128 | -600. | 12.180 | 23.468 | 25.351 | 0.000 | 0.0 |
| 31.000 | 21 | 6 | 1 | 4 | -600. | .000 | .000 | 7.225 | 0.000 | 0.0 |
| 32.000 | 22 | 6 | 5 | 9 | -600. | 11.788 | 21.983 | 22.066 | 0.000 | 0.0 |
| 33.000 | 23 | 6 | 10 | 20 | -600. | 10.122 | 14.690 | 17.317 | 0.000 | 0.0 |
| 34.000 | 24 | 6 | 21 | 34 | -700. | .000 | .000 | 1.5 | 0.000 | 0.0 |
| 35.000 | 25 | 6 | 35 | 69 | -500. | .000 | .000 | 2.0 | 0.000 | 0.0 |
| 36.000 | 26 | 6 | 70 | 81 | -500. | 12.116 | 24.918 | 25.482 | 0.000 | 0.0 |
| 37.000 | 27 | 6 | 82 | 90 | -500. | .000 | .000 | 1.9 | 0.000 | 0.0 |
| 38.000 | 28 | 6 | 91 | 110 | -500. | 9.344 | 10.770 | 15.039 | 0.000 | 0.0 |
| 39.000 | 29 | 6 | 111 | 118 | -500. | 12.170 | 23.214 | 22.008 | 0.000 | 0.0 |
| 40.000 | 30 | 6 | 119 | 122 | -500. | .000 | .000 | 1.1 | 0.000 | 0.0 |
| 41.000 | 31 | 6 | 123 | 128 | -500. | 9.542 | 11.208 | 15.583 | 0.000 | 0.0 |
| 42.000 | 32 | 7 | 1 | 13 | -500. | 10.122 | 14.690 | 17.317 | 0.000 | 0.0 |
| 43.000 | 33 | 7 | 14 | 33 | -500. | 10.171 | 29.904 | 28.590 | 0.000 | 0.0 |
| 44.000 | 34 | 7 | 34 | 52 | -500. | 10.763 | 17.670 | 18.244 | 0.000 | 0.0 |
| 45.000 | 35 | 7 | 53 | 57 | -500. | 4.183 | 27.873 | 20.986 | 0.000 | 0.0 |
| 46.000 | 36 | 7 | 58 | 83 | -700. | 4.233 | 31.368 | 27.002 | 0.000 | 0.0 |

Table 10. Listing of the Reference File BRG040F:3 Used in Scanning Data Analysis (Cont)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 47.000 | 37 | 7 | 84 | 98 | -500. | 5.404 | 20.919 | 38.897 | 0.000 | 0.0 |
| 48.000 | 38 | 7 | 99 | 109 | -700. | 4.183 | 11.053 | 22.304 | 0.000 | 0.0 |
| 49.000 | 39 | 7 | 110 | 128 | -700. | 4.183 | 25.871 | 12.707 | 0.000 | 0.0 |
| 50.000 | 40 | 8 | 1 | 128 | -200. | .000 | .000 | 5.0 | 0.000 | 0.0 |
| 51.000 | 41 | 9 | 1 | 12 | -200. | .000 | 38.902 | 11.641 | 0.000 | 0.0 |
| 52.000 | 42 | 9 | 13 | 17 | -200. | 11.254 | 21.843 | 20.385 | 0.000 | 0.0 |
| 53.000 | 43 | 9 | 18 | 52 | -100. | .000 | 31.987 | 23.934 | 0.000 | 0.0 |
| 54.000 | 44 | 9 | 53 | 57 | -200. | .000 | 123.644 | 23.919 | 0.000 | 0.0 |
| 55.000 | 45 | 9 | 58 | 78 | -200. | .000 | 31.227 | 17.898 | 0.000 | 0.0 |
| 56.000 | 46 | 9 | 79 | 83 | -200. | 11.790 | 21.983 | 22.064 | 0.000 | 0.0 |
| 57.000 | 47 | 9 | 84 | 114 | -200. | 10.122 | 14.690 | 17.317 | 0.000 | 0.0 |
| 58.000 | 48 | 9 | 115 | 121 | -200. | .000 | .000 | 1.5 | 0.000 | 0.0 |
| 59.000 | 49 | 9 | 122 | 128 | -100. | 11.934 | 25.180 | 23.918 | 0.000 | 0.0 |
| 60.000 | 50 | 10 | 1 | 10 | -700. | 4.419 | 36.438 | 33.271 | 0.000 | 0.0 |
| 61.000 | 51 | 10 | 11 | 23 | -700. | 6.682 | 6.488 | 8.494 | 0.000 | 0.0 |
| 62.000 | 52 | 10 | 24 | 31 | -700. | 3.850 | 19.695 | 36.938 | 0.000 | 0.0 |
| 63.000 | 53 | 10 | 32 | 39 | -700. | 4.169 | 11.728 | 25.372 | 0.000 | 0.0 |
| 64.000 | 54 | 10 | 40 | 52 | -700. | 4.183 | 10.175 | 22.029 | 0.000 | 0.0 |
| 65.000 | 55 | 10 | 53 | 57 | -700. | 4.183 | 16.249 | 16.783 | 0.000 | 0.0 |
| 66.000 | 56 | 10 | 58 | 68 | -700. | 4.183 | 23.055 | 13.746 | 0.000 | 0.0 |
| 67.000 | 57 | 10 | 69 | 76 | -700. | 4.183 | 20.783 | 12.007 | 0.000 | 0.0 |
| 68.000 | 58 | 10 | 77 | 88 | -700. | 4.183 | 42.178 | 9.039 | 0.000 | 0.0 |
| 69.000 | 59 | 10 | 89 | 93 | -700. | 4.183 | 63.176 | 10.114 | 0.000 | 0.0 |
| 70.000 | 60 | 10 | 94 | 101 | -700. | 4.183 | 73.162 | 9.710 | .000 | 0.0 |
| 71.000 | 61 | 10 | 102 | 107 | -700. | 4.183 | 58.910 | 7.951 | .000 | 0.0 |
| 72.000 | 62 | 10 | 108 | 113 | -700. | 4.183 | 80.953 | 15.447 | .000 | 0.0 |
| 73.000 | 63 | 10 | 114 | 123 | -700. | 9.719 | 11.610 | 16.002 | .000 | 0.0 |
| 74.000 | 64 | 10 | 124 | 128 | -600. | .000 | 52.901 | 14.148 | .000 | 0.0 |
| 75.000 | 65 | 11 | 1 | 64 | -50. | .000 | .000 | .999 | .000 | 0.0 |
| 76.000 | 66 | 11 | 65 | 74 | -50. | .099 | .000 | .599 | .000 | 0.0 |
| 77.000 | 67 | 11 | 75 | 92 | -50. | .000 | .000 | 1.999 | .000 | 0.0 |
| 78.000 | 68 | 11 | 93 | 99 | -50. | .000 | .000 | 2.199 | .000 | 0.0 |
| 79.000 | 69 | 11 | 100 | 128 | -50. | .000 | .000 | 6.999 | .000 | 0.0 |
| 80.000 | 70 | 12 | 1 | 8 | 0. | .000 | .000 | 9.999 | .000 | 0.0 |
| 81.000 | 71 | 12 | 9 | 22 | 0. | .000 | .000 | 14.099 | .000 | 0.0 |
| 82.000 | 72 | 12 | 23 | 35 | 0. | .000 | .000 | 13.999 | .000 | 0.0 |
| 83.000 | 73 | 12 | 36 | 48 | -25. | .000 | .000 | 9.999 | .000 | 0.0 |
| 84.000 | 74 | 12 | 49 | 61 | -25. | .000 | .000 | 6.999 | .000 | 0.0 |
| 85.000 | 75 | 12 | 62 | 74 | -50. | .000 | .000 | 3.999 | .000 | 0.0 |
| 86.000 | 76 | 12 | 75 | 88 | -75. | .000 | .000 | 1.999 | .000 | 0.0 |
| 87.000 | 77 | 12 | 89 | 101 | -150. | .000 | .000 | .499 | .000 | 0.0 |
| 88.000 | 78 | 12 | 102 | 114 | -150. | .000 | .000 | .099 | .000 | 0.0 |
| 89.000 | 79 | 12 | 115 | 121 | -150. | .000 | .000 | .010 | .000 | 0.0 |
| 90.000 | 80 | 12 | 122 | 128 | -100. | .000 | .000 | .010 | .000 | 0.0 |
| 91.000 | | | | | | | | | | |
| 92.000 | WLG | MN | STERS | | SAAADJ. | O | N2 | O2 | HE | BK* |
| 93.000 | | | | | | (ABSORPTION CROSS SECTIONS) | | | | |

*In a preliminary version of BRG040, reference values of backgrounds for each of the 80 WLG's were used.

Table 10. Listing of the Reference File BRG040F:3 Used in Scanning Data Analysis (Cont)

The reference file for scanning data analysis, reproduced on the preceding pages, contains all data used to control the programs BRG040, BRG043, BRG044, BRG047, and BRG048.

An explanation of the file follows:

A. Line 1: General Control Variables

| | |
|---|---|
| Column 1 | - Threshold for maximum optical depth acceptable. |
| Column 2 | - Threshold for maximum acceptable instrumental sensitivity correction (used by BRG040, BRG043). |
| Column 3 | - Version number (data of compilation (used by all programs for identification). |
| Column 4 | - Reference height for default model (this and all following data used by BRG043 only). |
| Column 5 | - Reference temperature for default model. |
| Columns 6-9 | - Particle densities for default model: O, $N_2$, $O_2$, $H_e$, respectively. |

B. Line 2: Limit Variables

| | |
|---|---|
| Column 1 | - Number of height/SAA distance pairs (used by BRG040, BRG043). |
| Column 2 | - Number of wavelength groups defined (used by all programs). |

C. Lines 3 through 10: Height/SAA Distance Threshold Table (used by BRG040, BRG043)

| | |
|---|---|
| Column 1 | - Height (adjusted by offset for each wavelength group) (km). |
| Column 2 | - Minimum distance from SAA for acceptance (deg). |

D. Lines 11 through 90: Wavelength Group Definitions and Group-Dependent Parameters

| | |
|---|---|
| Column 1 | - Group number. |
| Column 2 | - Monochromator number. |
| Columns 3-4 | - Range of steps covered by group. |
| Column 5 | - Height offset (added to satellite height when Section C table is used). |
| Columns 6-9 | - Absorption cross sections (in order O, $N_2$, $O_2$, $H_e$) used for correction for absorption (used by BRG040, BRG043). |

Table 10. Listing of the Reference File BRG040F:3 Used in Scanning Data Analysis (Cont)

D. Lines 11 through 90: (Cont)

Column 10 - Background correction (used by BRG040, BRG043) [recently background corrections were shifted into higher-order correction routines; therefore, this column now shows zeros only].

Columns 11-13 - Wavelength bandwidth and wavelength range covered by group (Å) (used by BRG047, BRG048).

Column 14 - Total flux for specified wavelength range in reference spectrum F74113 (used by BRG047, BRG048).

Column 15 - Estimated ratio July 1976/April 1974 solar flux (used by BRG047, BRG048) [not currently implemented].

Column 16 - Average of absorption-corrected count sums for July 1976

Table 11. Structure of Wavelength-Group Scanning Data File Records (Files consist of two classes of record, similar to those in the corrected scan files [see Table 9].)

Part 1: Header Record Structure (63-word record)

| Word Number | Quantity | Real or Integer |
|---|---|---|
| 1-61 | (Same as Table 9, Pt. 1). | |
| 62 | Version code. | I |
| 63 | Program code applying to original CSF. | I |

Part 2: Signal Record Structure (all real value)

| Word Number | Quantity |
|---|---|
| 1 | Weighted average integrated count (Wavelength Group 1). |
| 2 | Weighted average of number of scans (Wavelength Group 1). |
| 3 | Weighted average of standard deviations (Wavelength Group 1). |
| 4 | Weighted average of optical depths (Wavelength Group 1). |
| 5-320 | (Same as 1-4 for Wavelength Group 2-80). |

## 4. CONCLUSION

The present report describes the creation of two sets of data from the flux analysis procedure which are available from the Extreme Ultraviolet Spectrophotometer: fixed-wavelength flux data, obtained from both AE-C and AE-E, and wavelength-scan data, obtained from the satellite AE-E only. Fixed-wavelength data enable the study of time variations in solar flux in the extreme ultraviolet over periods of up to a year but with restriction to a limited number of wavelengths. Scanning data are available for only certain intervals in time, are smoothed for statistical considerations by averaging observations under similar solar conditions but consequently do not show short-term fluctuations. However, the whole of the solar spectrum in the extreme ultraviolet region observed by the EUVS is covered. Procedures of correction for overlapping higher orders of diffraction are currently in progress. They will be covered by a future report.

## References


1. Chaikin, L. M., and Fukui, K. EUV-Absorption Data Analysis for EUVS Experiments on the AE-Satellites (to be published).

2. Hinteregger, H. E., Bedo, D. E., and Manson, J. E. (1973) The EUV Spectrophotometer on Atmosphere Explorer, Radio Science, **8**(No. 4):349-359.

3. Hinteregger, H. E. (1976) EUV fluxes in the solar spectrum below 2000 Å, J. Atmos. Terr. Phys. **38**:791-806.

4. Hinteregger, H. E., Bedo, D. E., Manson, J. E., and Skillman, D. R. (1977) EUV flux variations with solar rotation observed during 1974 from AE-C satellite, Space Research XVIII, pp. 533-544.

5. Hedin, A. E., Salah, J. E., Evans, J. V., Reber, C. A., Newton, C. P., Spencer, N. W., Kayser, D. C., Alasyde, C., Bauer, P., Cogger, L., and McClure, J. P. (1977) A global thermospheric model based on mass spectrometer and incoherent scatter data: MSIS Part 1 - $N_2$ density and temperature, J. Geophys. Res. **82**:2139.

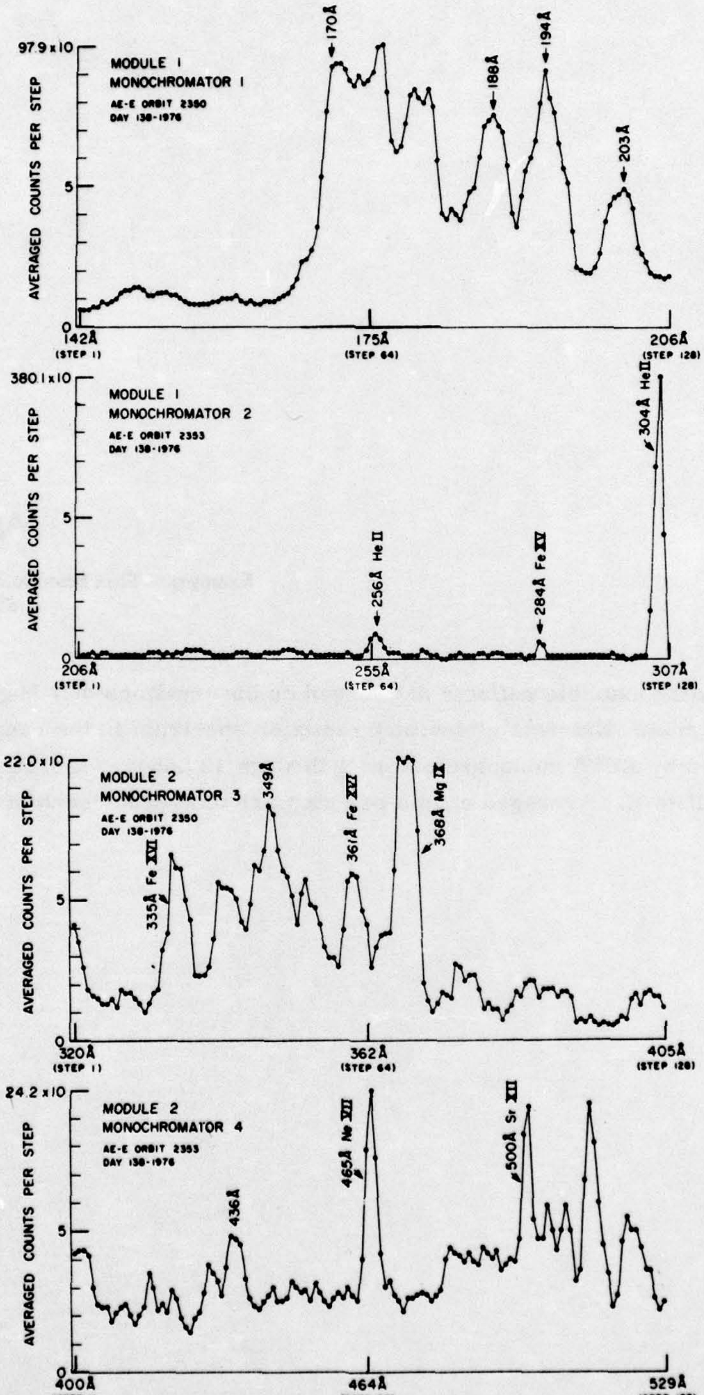
6. Hedin, A. E., Reber, C. A., Newton, C. P., Spencer, N. W., Brinton, H. C., Mayr, H. G., and Potter, W. E. (1977) A global thermospheric model based on mass spectrometer and incoherent scatter data: MSIS Part 2 - composition, J. Geophys. Res. **82**:2148.

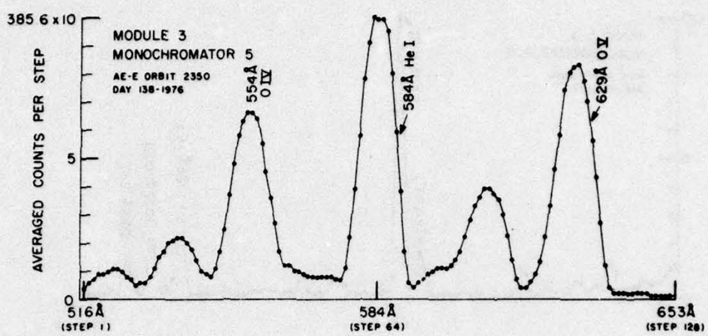
7. Jacchia, L. G. (1972) Atmospheric models in the region from 110 to 2000 km, in COSPAR International Reference Atmosphere 1972, Akademie-Verlag Berlin, pp. 227-338.

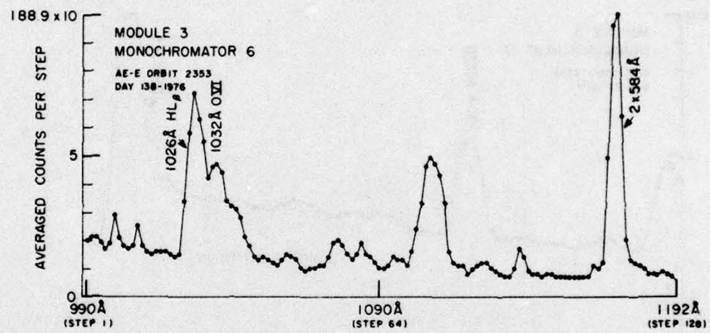
# Appendix A

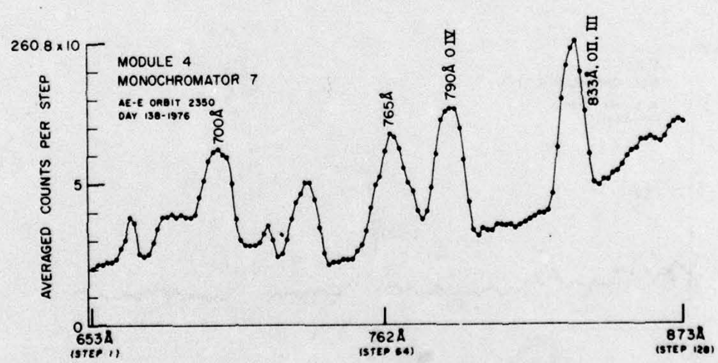
## Example of Flux Scan Data of Individual SE-File Records

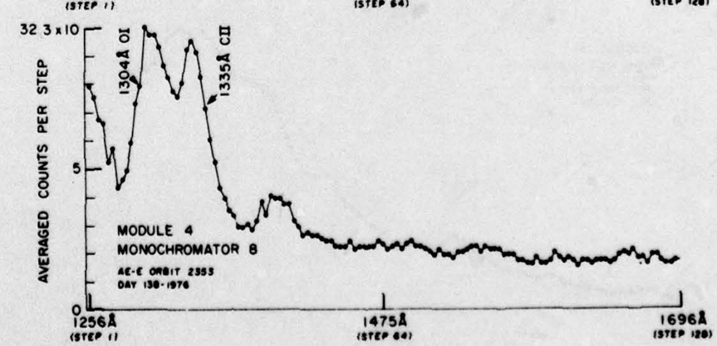
The following example reflects data based on observations of 7 May 1976 near the solar minimum: Extreme ultraviolet radiation spectrum in the range of 140 to 1850 Å obtained by EUVS monochromators 1 through 12 onboard the Atmosphere Explorer Satellite E. Averaged counts per step are plotted for each step number.

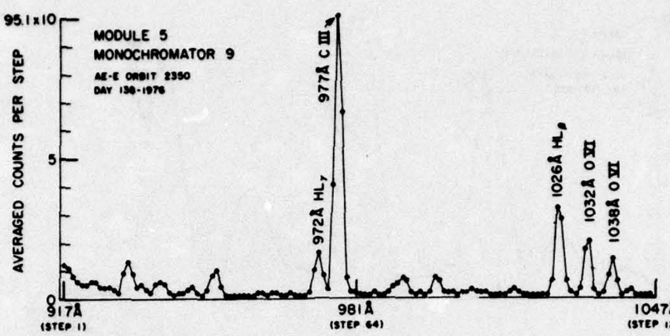

97.9 x 10
MODULE 1
MONOCHROMATOR 1
AE-E ORBIT 2350
DAY 138-1976
AVERAGED COUNTS PER STEP
170Å
188Å
194Å
203Å
142Å
(STEP 1)
175Å
(STEP 64)
206Å
(STEP 128)
380.1 x 10
MODULE 1
MONOCHROMATOR 2
AE-E ORBIT 2353
DAY 138-1976
304Å He II
256Å He II
284Å Fe XV
206Å
255Å
307Å
22.0 x 10
MODULE 2
MONOCHROMATOR 3
AE-E ORBIT 2350
DAY 138-1976
335Å Fe XVI
349Å
361Å Fe XVI
368Å Mg IX
320Å
362Å
405Å
24.2 x 10
MODULE 2
MONOCHROMATOR 4
AE-E ORBIT 2353
DAY 138-1976
436Å
465Å Ne VII
500Å Sr XII
400Å
464Å
529Å


385.6 x 10
MODULE 3
MONOCHROMATOR 5
AE-E ORBIT 2350
DAY 138-1976
554Å O IV
584Å He I
629Å O V
AVERAGED COUNTS PER STEP
5
0
516Å
(STEP 1)
584Å
(STEP 64)
653Å
(STEP 128)

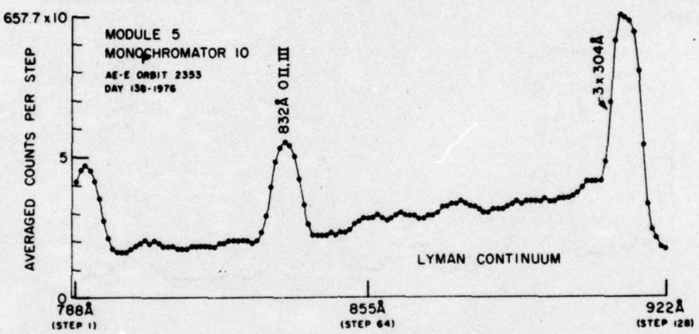

188.9 x 10
MODULE 3
MONOCHROMATOR 6
AE-E ORBIT 2353
DAY 138-1976
1026Å HL
1032Å O VI
2x584Å
AVERAGED COUNTS PER STEP
5
0
990Å
(STEP 1)
1090Å
(STEP 64)
1192Å
(STEP 128)


260.8 x 10
MODULE 4
MONOCHROMATOR 7
AE-E ORBIT 2350
DAY 138-1976
700Å
765Å
790Å O IV
833Å, O II, III
AVERAGED COUNTS PER STEP
5
0
653Å
(STEP 1)
762Å
(STEP 64)
873Å
(STEP 128)

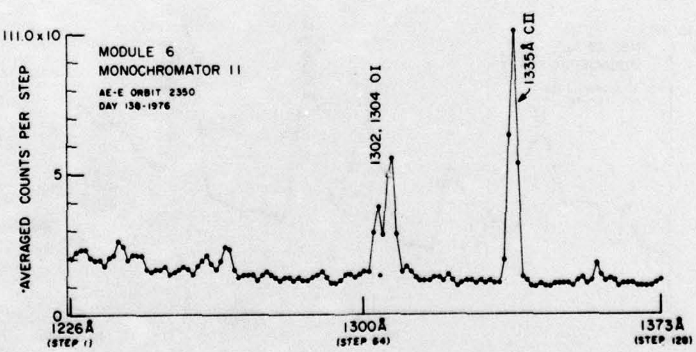

32.3 x 10
1304Å O I
1335Å C II
MODULE 4
MONOCHROMATOR 8
AE-E ORBIT 2353
DAY 138-1976
AVERAGED COUNTS PER STEP
5
0
1256Å
(STEP 1)
1475Å
(STEP 64)
1696Å
(STEP 128)



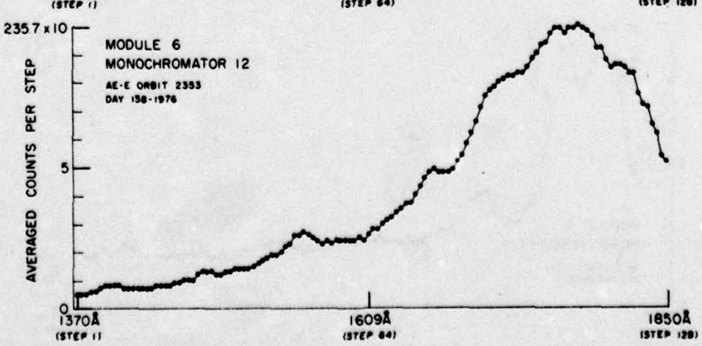
95.1x10
5
0
AVERAGED COUNTS PER STEP
MODULE 5
MONOCHROMATOR 9
AE-E ORBIT 2350
DAY 138-1976
977Å C III
972Å HL$_\gamma$
1026Å HL$_\beta$
1032Å O VI
1038Å O VI
917Å
(STEP 1)
981Å
(STEP 64)
1047Å
(STEP 128)

657.7x10
5
0
AVERAGED COUNTS PER STEP
MODULE 5
MONOCHROMATOR 10
AE-E ORBIT 2353
DAY 138-1976
832Å O II, III
3x 304Å
LYMAN CONTINUUM
788Å
(STEP 1)
855Å
(STEP 64)
922Å
(STEP 128)

111.0x10
5
0
AVERAGED COUNTS PER STEP
MODULE 6
MONOCHROMATOR 11
AE-E ORBIT 2350
DAY 138-1976
1302, 1304 O I
1335Å C II
1226Å
(STEP 1)
1300Å
(STEP 64)
1373Å
(STEP 128)

235.7x10
5
0
AVERAGED COUNTS PER STEP
MODULE 6
MONOCHROMATOR 12
AE-E ORBIT 2353
DAY 138-1976
1370Å
(STEP 1)
1609Å
(STEP 64)
1850Å
(STEP 128)

# Appendix B

**Composite Flux Scan Data for July 1976**
**Produced by Program BRG040**

The Solar EUV of July 1976 (spectrum range from 140 to 1850 Å) from EUVS experiment on the Atmosphere Explorer Satellite E includes the 128 scan steps of each monochromator. These represent averages of 50 to 100 count samples, individually corrected for both instrumental effects and atmospheric absorption.

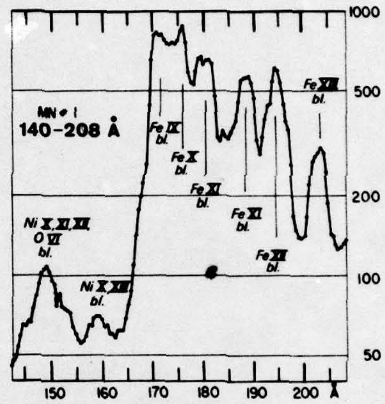
## SOLAR EUV OF JULY 1976
### SPECTRUM FROM 140 TO 1850 Å FROM EUVS EXPERIMENT ON AE-E

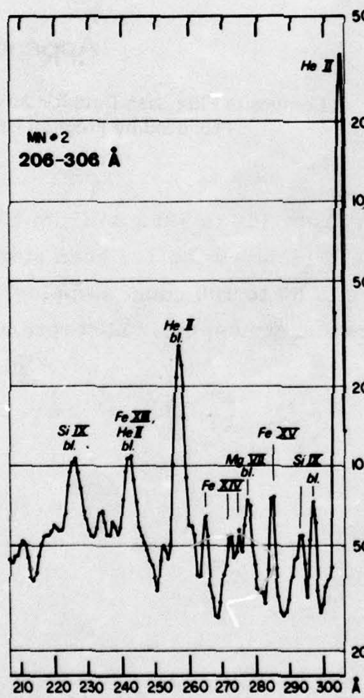
*(Average from 24 orbits in period of July 13-28 for which the observing conditions were best)*

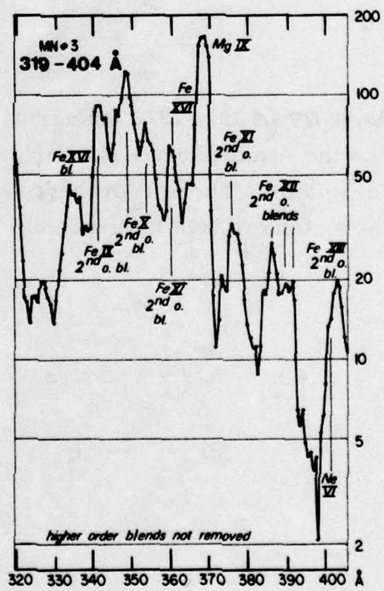
*The points shown for the 128 scan steps of each monochromator are averages of 50-100 count samples, individually corrected for both instrumental effects and atmospheric absorption.*

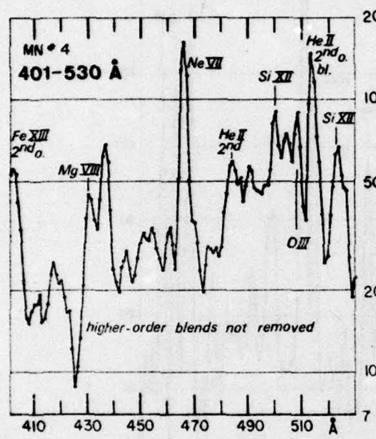
SCALE OF ORDINATES : LOG

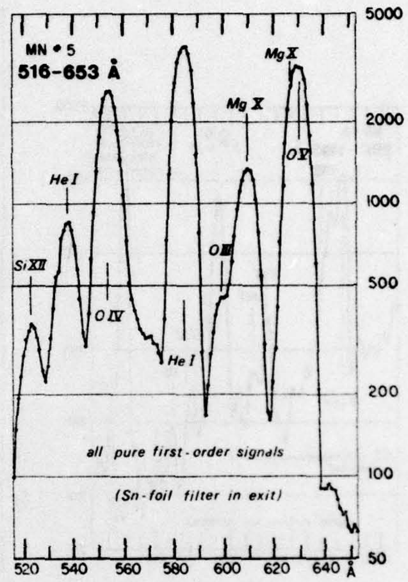
UNITS OF COUNTS PER 0.35 SEC

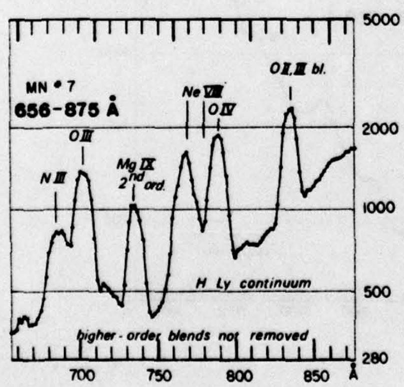


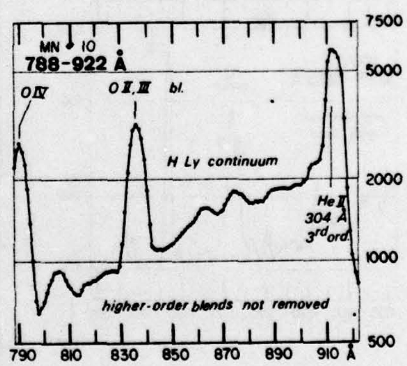



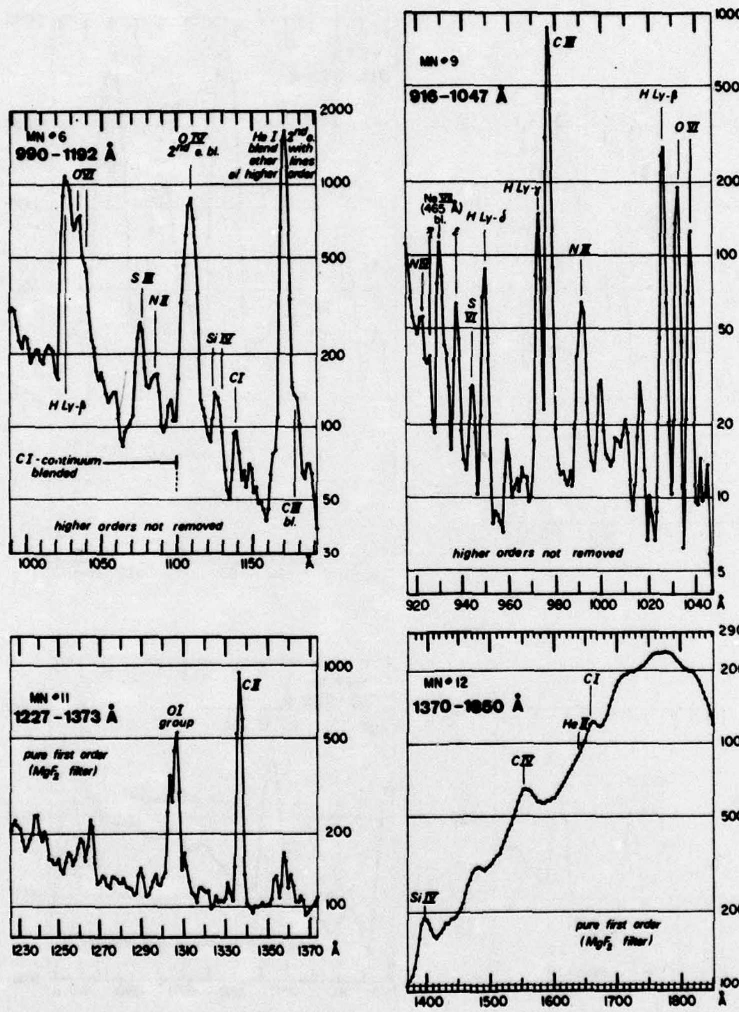




MN # 4
401-530 Å
Fe XIII 2nd o.
Mg VIII
Ne VIII
He II 2nd
Si XII
He II 2nd o. bl.
O III
Si XII
higher-order blends not removed
200
100
50
20
10
7
410
430
450
470
490
510
Å


MN # 5
516-653 Å
Si XII
He I
O IV
He I
O III
Mg X
Mg X
O V
all pure first-order signals
(Sn-foil filter in exit)
5000
2000
1000
500
200
100
50
520
540
560
580
600
620
640
Å


MN # 7
656-875 Å
N III
O III
Mg IX 2nd ord.
Ne VIII
O IV
O II, III bl.
H Ly continuum
higher-order blends not removed
5000
2000
1000
500
280
700
750
800
850
Å

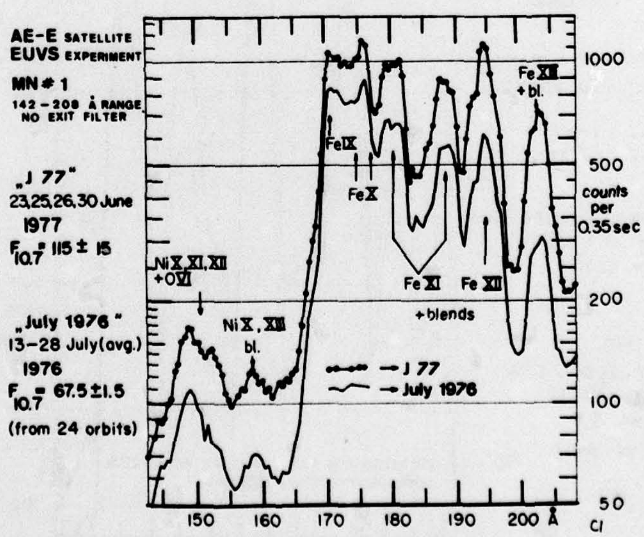

MN # 10
788-922 Å
O IV
O II, III bl.
H Ly continuum
He II 304 Å 3rd ord.
higher-order blends not removed
7500
5000
2000
1000
500
790
810
830
850
870
890
910
Å

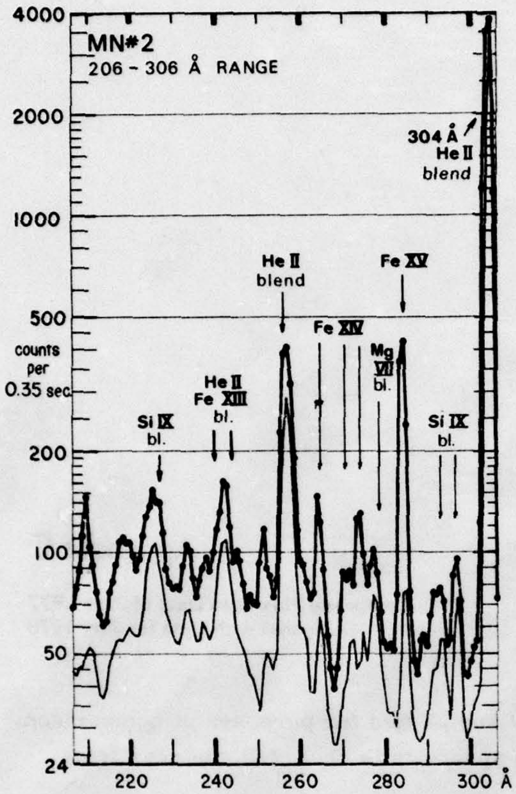

MN° 6
990 - 1192 Å
higher orders not removed
CI - continuum blended
H Ly-β
MN° 9
916-1047 Å
higher orders not removed
C III
H Ly-β
H Ly-γ
H Ly-δ
MN° 11
1227 - 1373 Å
pure first order (MgF2 filter)
OI group
C II
MN° 12
1370-1860 Å
pure first order (MgF2 filter)
Si IV
C IV
C I

# Appendix C

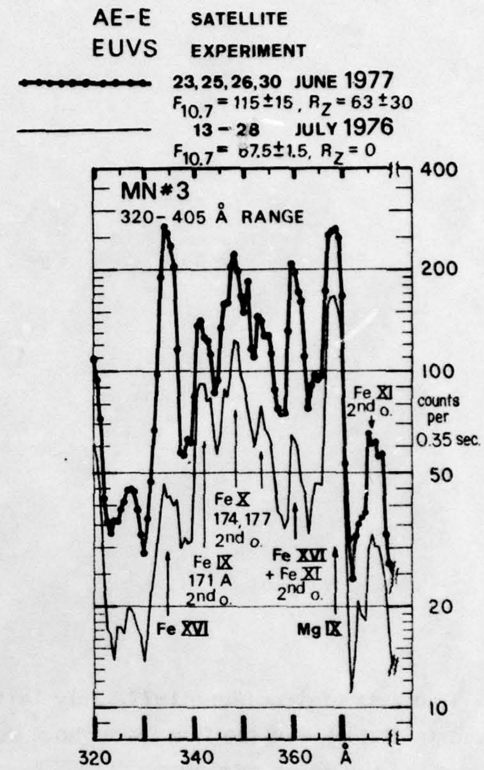
**Composite Flux Scan Data of June 1977 Compared with Data for July 1976**

Two sets of data (June 1977, July 1976) are plotted for purposes of comparison. A substantial rise of the flux throughout the spectrum is observed one year from the date of the solar minimum.

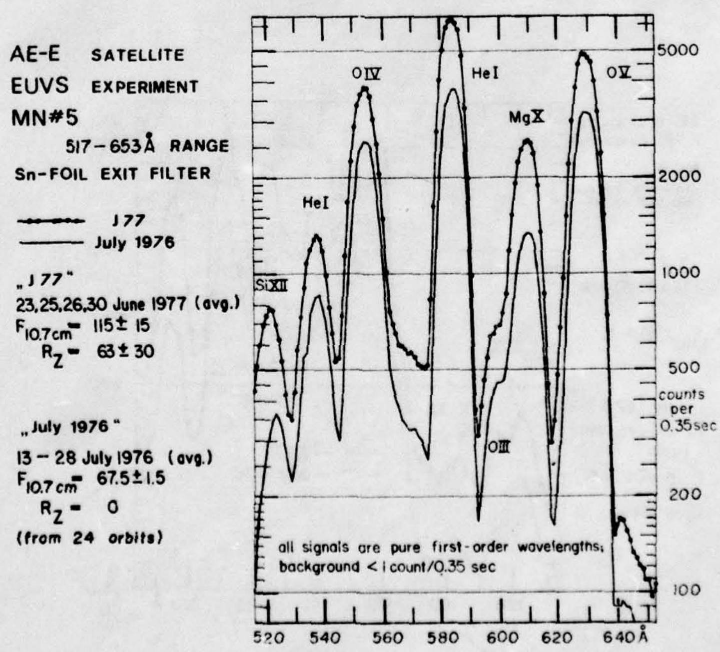




MN#2
206 - 306 Å RANGE
4000
2000
1000
500
200
100
50
24
counts per 0.35 sec
Si IX bl.
He II Fe XIII bl.
He II blend
Fe XIV
Mg VII bl.
Fe XV
Si IX bl.
304 Å He II blend
220
240
260
280
300 Å

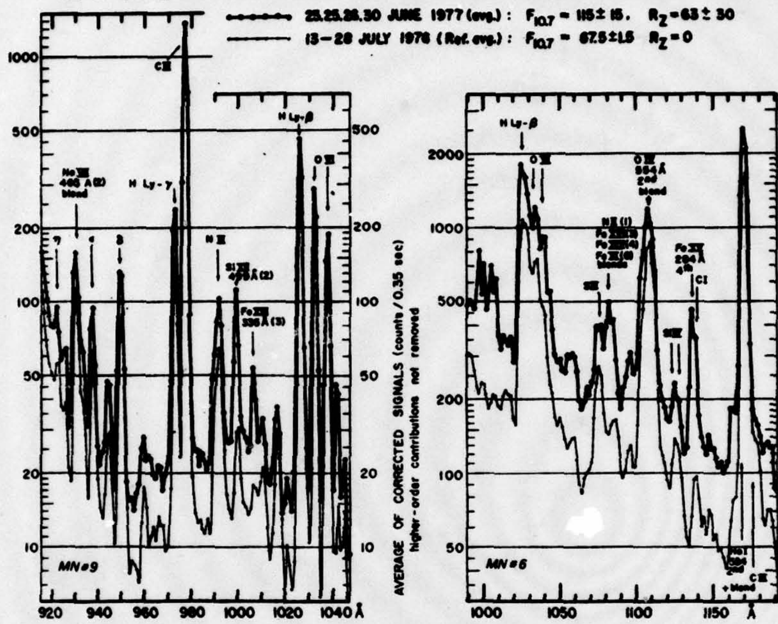



AE-E SATELLITE
EUVS EXPERIMENT
23,25,26,30 JUNE 1977
$F_{10.7}$ = 115±15, $R_Z$ = 63±30
13 - 28 JULY 1976
$F_{10.7}$ = 67.5±1.5, $R_Z$ = 0
MN#3
320- 405 Å RANGE
400
200
100
50
20
10
counts per 0.35 sec.
Fe XI 2nd o.
Fe X 174, 177 2nd o.
Fe IX 171 A 2nd o.
Fe XVI + Fe XI 2nd o.
Fe XVI
Mg IX
320
340
360
Å

AE-E SATELLITE
EUVS EXPERIMENT
MN#5
517-653 Å RANGE
Sn-FOIL EXIT FILTER
J 77
July 1976
„J 77"
23,25,26,30 June 1977 (avg.)
$F_{10.7cm}$ = 115 ± 15
$R_Z$ = 63 ± 30
„July 1976"
13 - 28 July 1976 (avg.)
$F_{10.7cm}$ = 67.5 ± 1.5
$R_Z$ = 0
(from 24 orbits)
Si XII
He I
O IV
He I
Mg X
O V
O III
all signals are pure first-order wavelengths; background < 1 count/0.35 sec
5000
2000
1000
500
200
100
counts per 0.35sec
520
540
560
580
600
620
640 Å

AE-E SATELLITE EUVS EXPERIMENT DATA FROM MONOCHROMATORS 6 AND 9




AE-E EUVS Monochromator # 10: 788 – 922 Å (no filter used)